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NATIONAL DAM SAFETY PROGRAM. GREGORY'S POND DAM (VA-04122), MID--ETC(U)
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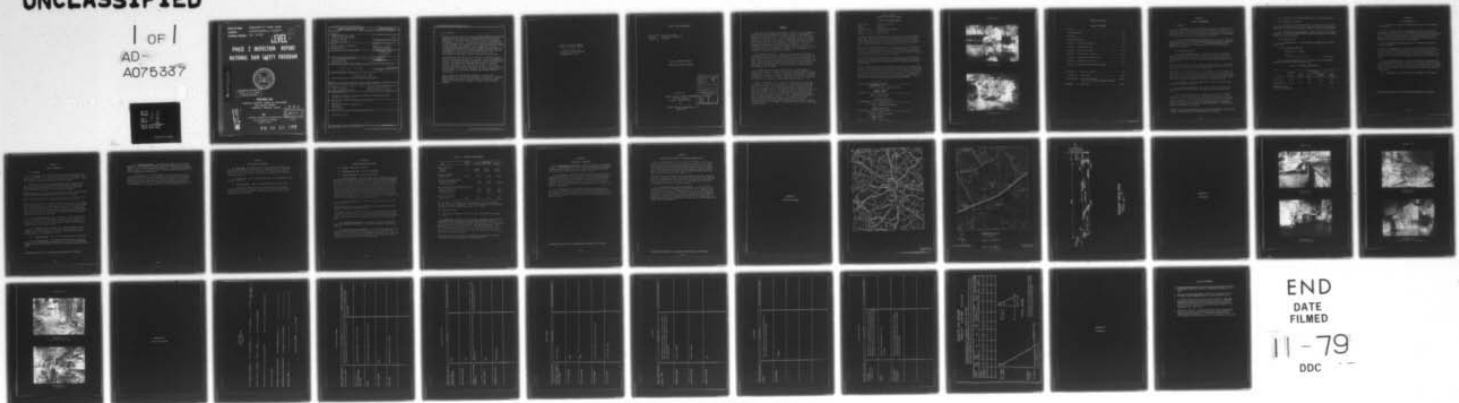
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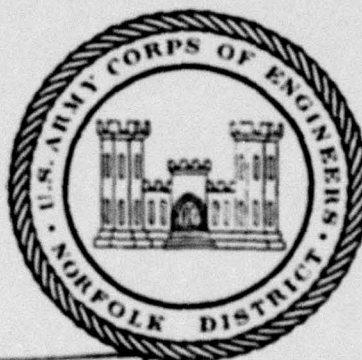
Name Of Dam: GREGORY'S POND DAM
Location: CHESTERFIELD COUNTY
Inventory Number: VA. 04122

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PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

AD A075337



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PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

BY

DEWARD M. MARTIN & ASSOCIATES
WILLIAMSBURG, VIRGINIA
AUGUST, 1979

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER VA 04122	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program GREGORY'S POND DAM Chesterfield County, VA		5. TYPE OF REPORT & PERIOD COVERED Final
7. AUTHOR(s) DEWARD M. MARTIN & ASSOCIATES WILLIAMSBURG, VA		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s) 15 DM-DACW 65-78-D-0015
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Engineering District, Norfolk 803 Front Street Norfolk, VA 23510		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 12 36
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 9 Final rept.		12. REPORT DATE August 1979
		13. NUMBER OF PAGES
		15. SECURITY CLASS. (of this report) Unclassified
16. DISTRIBUTION STATEMENT (of this Report) 10 Paul/Seiler Approved for public release; distribution unlimited.		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) National Dam Safety Program. Gregory's Pond Dam (VA-04122), Chesterfield County, Virginia. Phase I Inspection Report. Middle James River Basin,		
18. SUPPLEMENTARY NOTES Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams - VA National Dam Safety Program Phase I Dam Safety Dam Inspection		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) (See reverse side) 411 362		

20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

GREGORY'S POND DAM
CHESTERFIELD COUNTY, VIRGINIA
INVENTORY NO. 04122

MIDDLE JAMES RIVER BASIN

Name of Dam: Gregory's Pond Dam
Location: Chesterfield County, VA
Inventory: VA 04122

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared for
NORFOLK DISTRICT CORPS OF ENGINEERS
803 Front Street
Norfolk, Virginia 23510

by

Deward M. Martin & Associates, Inc.
August 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

BRIEF ASSESSMENT OF DAM

Name of Dam: Gregory's Pond Dam
State: Virginia
County: Chesterfield
USGS Quad Sheet: Chesterfield, Virginia
Stream: Falling Creek
Date of Inspection: June 26, 1979

Gregory's Pond Dam is a Masonry structure about 166 feet long and 14 feet high. The dam is owned and operated by the Broad Rock Fishing Club, Richmond, Virginia. The dam is classified as small in size with a significant hazard classification. The spillway is a masonry weir 138 feet long with a crest elevation of 167.0 feet m.s.l.

Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the Spillway Design Flood is the 100-year flood. The spillway will pass 20% of the Spillway Design Flood without overtopping the dam. The SDF will overtop the dam by 4.5 feet. The spillway is therefore adjudged inadequate.

The visual inspection revealed some problems which require remedial action. There are several leaks in the dam which should be corrected and the owner should see that the vegetation is removed from the dam and abutments.

*It is recommended that an investigation be conducted to determine the nature of the dam foundation and structure and the extent of weathering of both. If irregularities or weathering of the foundation or the dam are observed, then a stability analysis of the dam should be conducted. The observed leaks should be monitored to determine if repairs are necessary. The cause of the bulge in the dam and the significance of its effect on the dam stability should also be determined.

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Colonel, Corps of Engineers

District Engineer

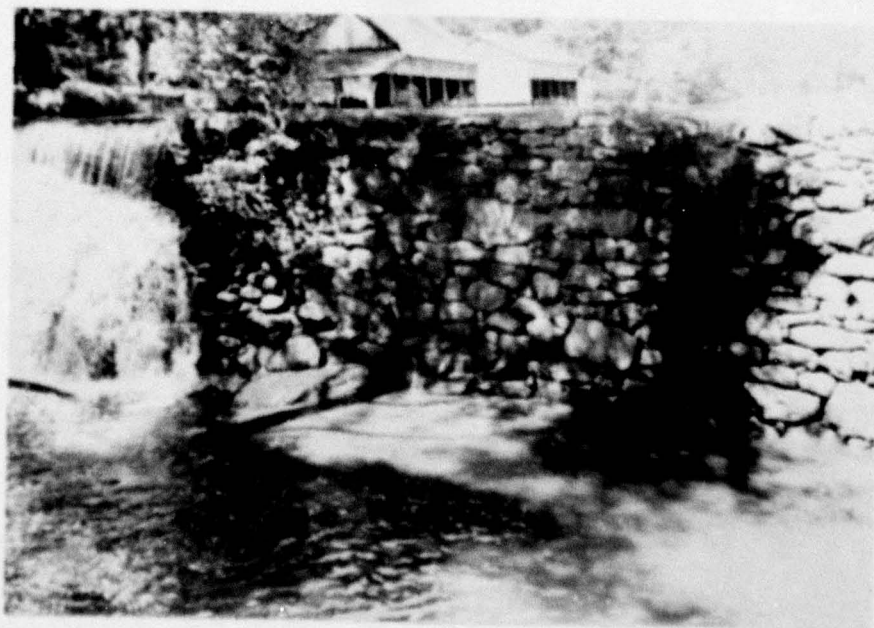
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GREGORY'S DAM



Overview of Dam



Downstream Face

GREGORY'S POND DAM

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SECTION 1

PROJECT ENGINEERING

1.1 General:

1.1.1 Authority: Public Law 92-367, 8 August 1972 authorized the Secretary of the Army, through the Corps of Engineers to initiate a national program of safety inspections of dams through the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Appendix IV, Reference 1). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: Gregory's Pond Dam is a masonry structure approximately 166 feet long and 14 feet high.* The crest of the dam is about one foot wide at an elevation of 169.0 feet m.s.l. The upstream side has a 1(H):1(V) slope and the downstream side is vertical.

The dam is constructed of large rocks laid without mortar. On the upstream face of the dam there is parging from the crest down to the base of the dam. (See sketch on Plate 1, Appendix I.)

The spillway is a masonry weir 138 feet long with a crest elevation of 167.0 feet. There is a 2-foot x 2-foot box culvert, located under the mill, which can be used to empty the pond. This box culvert was originally used as a part of the milling operation. The inlet to the culvert can be opened manually through the use of a 24-inch slide gate.

1.2.2 Location: Gregory's Pond Dam is located on Falling Creek one half mile north of Route 360.

1.2.3 Size Classification: The dam is classified as small in size because of height (14 feet) and maximum storage capacity (368 acre feet.)

1.2.4 Hazard Classification: This dam is located in a suburban area with the possibility that five inhabitable structures could be affected by it. It is therefore given a significant hazard classification in accordance with guidelines contained in Section 2.1.2 of Reference 1, Appendix V. The hazard classification used to categorize dams is a function of location only and has nothing to do with its stability or probability of failure.

*Height is based on the difference in elevation between the crest of the dam and the streambed at the downstream toe of the dam.

1.2.5 Ownership: Broad Rock Fishing Club, Richmond, Virginia.

1.2.6 Purpose: Recreation.

1.2.7 Design and Construction History: The dam was constructed about 1901 by the owners of the mill to provide power for the milling operation. No plans or construction details on the dam were available.

1.2.8 Normal Operating Procedure: Normal operation of the dam is automatic. As water rises above the spillway crest elevation it automatically passes downstream.

1.3 Pertinent Data:

1.3.1 Drainage Area: The dam controls a drainage area of 21.27 square miles.

1.3.2 Discharge at Dam Site:

Maximum flood - unknown

Spillway

pool level at top of dam 1,300 c.f.s.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

Table 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet m.s.l.	Area acres	Reservoir Capacity		Length miles
			Acre feet	Watershed inches	
Top of Dam	169.0	74	368	0.3	1.23
Spillway Crest	167.0	46	248	0.2	0.95
Streambed at the toe of the dam 155+		--	--	--	--

SECTION 2

ENGINEERING DATA

2.1 Design: No drawings or design calculations were available on this dam.

*2.1.2 Geologic Setting of the Dam: The dam is located in the Piedmont Geologic Region. The underlying bedrock is the Petersburg Granite which is a Paleozoic or Precambrian Formation of uncertain age. The granite bedrock is typically a gray microcline, biotite granite with seams of granodiorite. Numerous rock outcrops are exposed at the ground surface in the dam vicinity.

*2.1.3 Available Geotechnical Data: No previous geotechnical data is available.

*2.1.4 Dam Foundation: Due to the shallow bedrock (granite is exposed at the ground surface throughout most of the dam site) it is expected that the dam embankment bears directly on intact granite bedrock. Since no construction plans or reports are available, it is not possible to confirm the foundation material at this writing, however.

*2.1.5 Dam Structure: The masonry dam consists of granite rock. We understand from Bob Bates, a club member, that the embankment material was quarried from a site just south of the existing dam. The stone was placed vertical on the downstream side with a slope on the upstream side. It is not known if any type of mortar was used during the dam construction.

*2.2 Evaluation: Insufficient data is available to evaluate.

*Information provided by Law Engineering Associates of Virginia.

SECTION 3

VISUAL INSPECTION

3.1 Findings:

3.1.1 General: The results of the 26 June 1979 inspection are included in Appendix III. At the time of the inspection the pool elevation was 167.0 feet m.s.l. which is the crest of the spillway. There are no previous inspection reports of the dam available.

3.1.2 Dam: There was no obvious displacement of stones in the dam, however, some displacements in alignment, both horizontal and vertical were noted (see Section 3.1.4). Small trees, shrubs and vines were observed growing on the spillway and abutments.

*Visual observation of the dam axis revealed that the left third of the dam bowed downstream approximately one foot out of alignment.

*Rock outcrops were observed along the downstream toe and banks at the dam. The rock consisted of granite with some quartz intrusions.

*Seepage was observed at several locations through the dam. Two sizable leaks were observed, each estimated to be more than 10 gallons per minute. The first leak was located near the base of the dam just left of the rock outcropping to the right side of the dam. A second sizable leak was observed at the left abutment near the dam's contact with the mill. (See Plate No. 1, Appendix I). The leaks did not reflect any noticeable deterioration in the dam.

3.1.3 Appurtenant Structures: There is a 2-foot x 2-foot concrete box culvert located at the base of the mill house which can be used to drain the pond. This culvert can be opened by a manually operated slide gate which is inside the mill. Both the gate and the culvert seem to be in good condition.

3.1.4 Spillway: This spillway is a masonry structure 138 feet long with a crest elevation of 167.0 feet. There appeared to be a slight bulge in the spillway (about 1 foot) midway along the crest (see Appendix II, Photographs 1, 2 and 4.)

3.1.5 Instrumentation: There is no instrumentation on this dam.

3.1.6 Reservoir Area: The area surrounding the dam is heavily wooded and flat with slopes approximately 3%. There is no riprap protection around the dam, however, there were no signs of erosion of the banks.

*Information provided by Law Engineering Associates of Virginia.

3.1.7 Downstream Channel: The downstream channel is the natural stream. It is approximately 100 feet wide with relatively flat slopes. There are no structures immediately downstream. About a mile downstream, however, there are two homes in the Falling Creek Subdivision and five in the Longwood Acres Subdivision.

3.2 Evaluation: The visual inspection of this dam revealed several deficiencies. The trees, shrubs and vines growing on and around the dam and abutments should be removed and a program for its control should be initiated. The leaks in the dam should also be repaired. The bulge that was noted in the dam should be investigated by the owner or his engineer to determine its effect on the stability of the dam.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure: The regulation of the pool level is automatic as the water rises above the spillway crest elevation of 167.0. The pond is currently used strictly for recreation. The pond can be emptied through a 2-foot x 2-foot box culvert which is controlled by a manually operated slide gate.

4.2 Maintenance: At the current time there is no maintenance program for the dam.

4.3 Warning System: There is no warning system for this dam.

4.4 Evaluation: This dam does not require an extensive operational and maintenance procedure. However, it is recommended that an annual maintenance and inspection program be initiated to help detect and control future problems.

SECTION 5

HYDRAULIC/HYDROLOGIC DATA

5.1 Design: None were available.

5.2 Hydrologic Records: None were available.

5.3 Flood Experience: No records available.

5.4 Flood Potential: The PMF, $\frac{1}{4}$ PMF, and the 100-year flood were developed and routed through the reservoir by use of the HEC-1 computer program (Reference 2, Appendix IV) and appropriate unit hydrograph, precipitation, and storage-outflow data. Clark's Tc and R coefficients for the local drainage area were estimated from basin characteristics. The rainfalls applied to the developed unit hydrograph were obtained from the U S Weather Bureau Publications, Hydrometeorological Report No. 33 (Reference 3, Appendix IV) for PMP and Technical Paper No. 40 (Reference 4, Appendix IV) for the 100-year flood. Losses were estimated at an initial loss of 1.0 inch and a constant loss thereafter of 0.05 inch/hour for the PMF and 1.5 inch initial loss 0.15 inch/hour constant loss, respectively, for the 100 year flood.

5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1

Water flows past the dam over the spillway in the event water in the reservoir rises above elevation 167.0.

The storage curve was calculated by use of U S Geological Survey Quadrangle Maps. Rating curves were developed for the spillway and non-overflow section of the dam. In routing hydrographs through the reservoir, it was assumed that the initial pool level was at the spillway crest.

5.6 Overtopping Potential: The probable rise of the reservoir and other pertinent information on reservoir performance is shown in Table 5.1.

5.7 Reservoir Emptying Potential: A 24-inch slide gate near the old mill house at elevation 159.0 is available for dewatering the reservoir. The gate will permit withdrawal of about 44 c.f.s. with the reservoir level at the crest of the spillway and essentially dewater the reservoir to elevation 159.0 in about 7 days.

Table 5.1 RESERVOIR PERFORMANCE

Item	Normal flow	Hydrograph		
		100-Yr. (c)	1/2 PMF	PMF (a)
Peak flow c.f.s.				
Inflow	21	8,769	24,477	48,955
Outflow	--	8,365	23,108	45,257
Maximum elevation feet, m.s.l.	167.0	173.5	179.6	186.6
Spillway (elevation 167.0)				
Depth of flow, feet		6.5	12.6	19.6
Velocity, fps (b)		12.1	16.8	21.0
Non-overflow section (elevation 169.0)				
Depth of flow, feet		4.5	10.6	17.6
Duration, hours		12	28	39
Velocity, fps (b)		9.6	14.8	19.0
Tailwater elevation feet, m.s.l.	155+	167+	175+	182+

(a) The PMF is an estimate of flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonable possible in the region.

(b) Critical velocity

(c) The 100 year flood has 1 chance in 100 of occurring in any given year.

5.8 Evaluation: Based on the size (small) and hazard classification (significant,) the recommended Spillway Design Flood is 100-year to 1/2 PMF. Based on the risk involved in this project, it is considered that 100-year flood is appropriate as a Spillway Design Flood. The spillway will pass 20% of the 100-year flood without overtopping the dam. The 100-year flood will overtop the dam for 12 hours and reach a maximum of 4.5 feet over the top of the dam, with an average critical velocity of 9.6 feet per second.

Conclusions pertain to present day conditions. The effect of future development on the hydrology has not been considered.

SECTION 6

STRUCTURAL STABILITY

*6.1 Foundation and Abutments: Since there are no construction plans or data available it is not possible to confirm the foundation material, however, from the visual inspection it appears that the dam is probably founded on intact granite bedrock.

6.2 Structural: The dam is constructed of granite rock which was quarried near the construction site. From observations and discussion with the owner it was determined that the dam was probably constructed without any type of mortar. A vertical layer of clay may have been placed between layers of stone to act as a moisture barrier. The concrete "parging" on the upstream face of the dam also helps to retain water.

6.3 Evaluation: Due to the lack of design and construction records it is difficult to accurately evaluate the stability of the dam, however, the visual inspection revealed several significant leaks as well as horizontal misalignment which places the stability of the dam in question.

*information provided by Law Engineering Associates of Virginia.

SECTION 7

ASSESSMENT AND REMEDIAL MEASURES/RECOMMENDATIONS

*7.1 Dam Assessment: There are several items which affect the stability of the dam that are in question. The nature of the foundation material and the geometry and composition of the dam are uncertain. Also the extent of weathering of the dam foundation is unknown. The cause for the bulge in the dam and the possible effects are not known. The observed leaks could lead to additional weathering of the dam structure which could induce weakness.

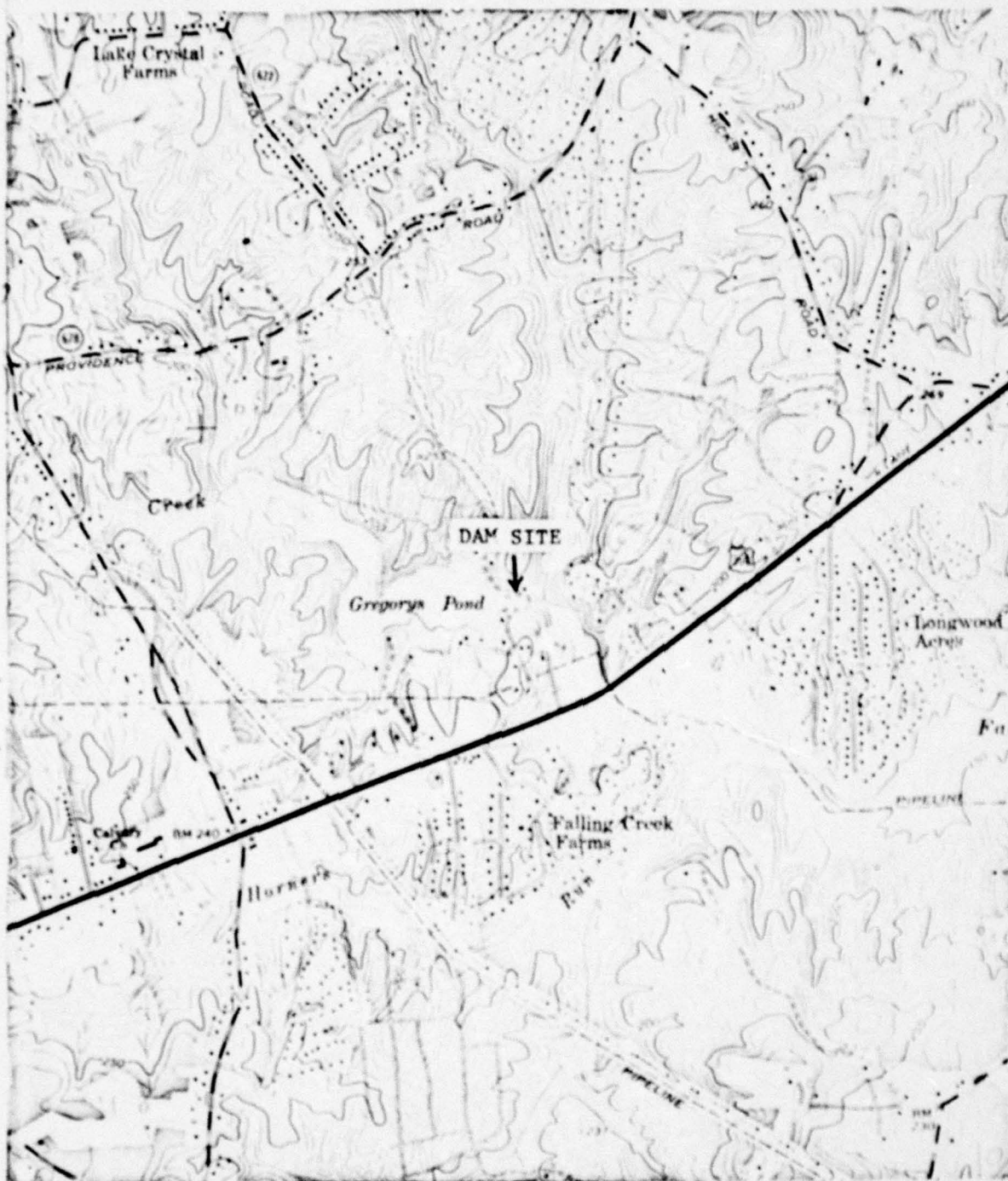
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*7.2 Remedial Measures and Recommendations: An investigation should be conducted to determine the nature of the dam foundation and structure and the extent of weathering of both. If irregularities or weathering of the foundation or the dam are observed, then a stability analysis of the dam should be conducted. The observed leaks should be monitored to determine if repairs are necessary. The cause of the bulge in the dam and the significance of its effect on the dam stability should also be determined.

APPENDIX I
MAPS AND DRAWINGS



REGIONAL MAP
GREGORY'S DAM



UTM GRID AND 1974 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

CHESTERFIELD, VA.

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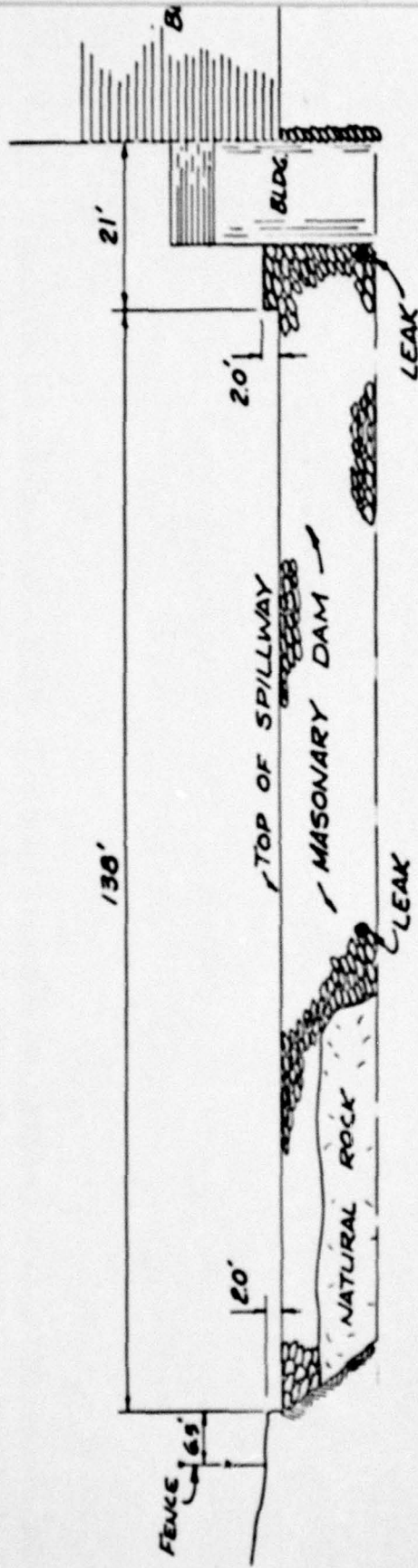
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SCALE: 1" = 2000'
10' Contours

VICINITY MAP
GREGORY'S DAM

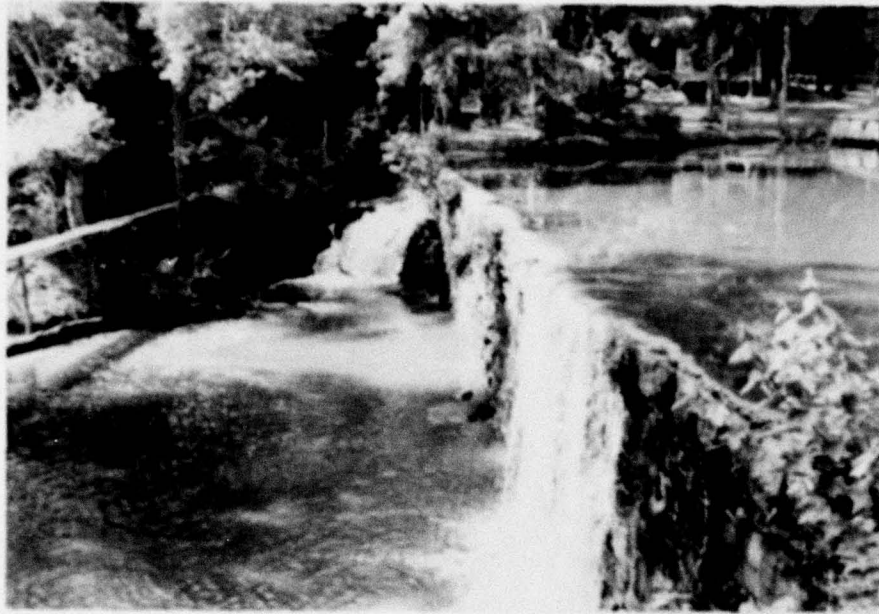


GREGORY POND DAM
 SCALE : 1" = 20'
 PLATE NO. 1

APPENDIX II

PHOTOGRAPHS

GREGORY'S DAM

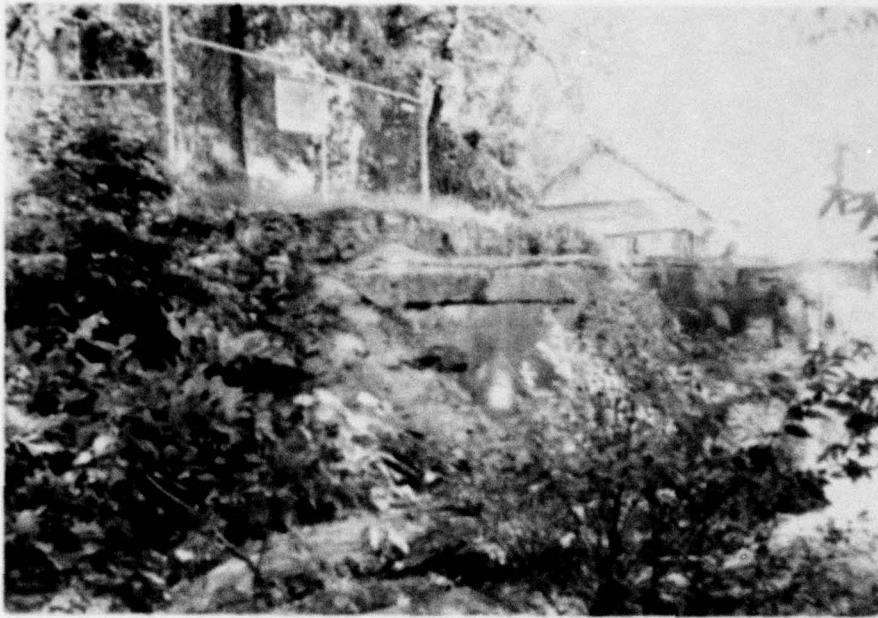


PHOTOGRAPH NO. 1
Dam and Pond



PHOTOGRAPH NO. 2
Front View of Dam

GREGORY'S DAM



PHOTOGRAPH NO. 3
Right Abutment

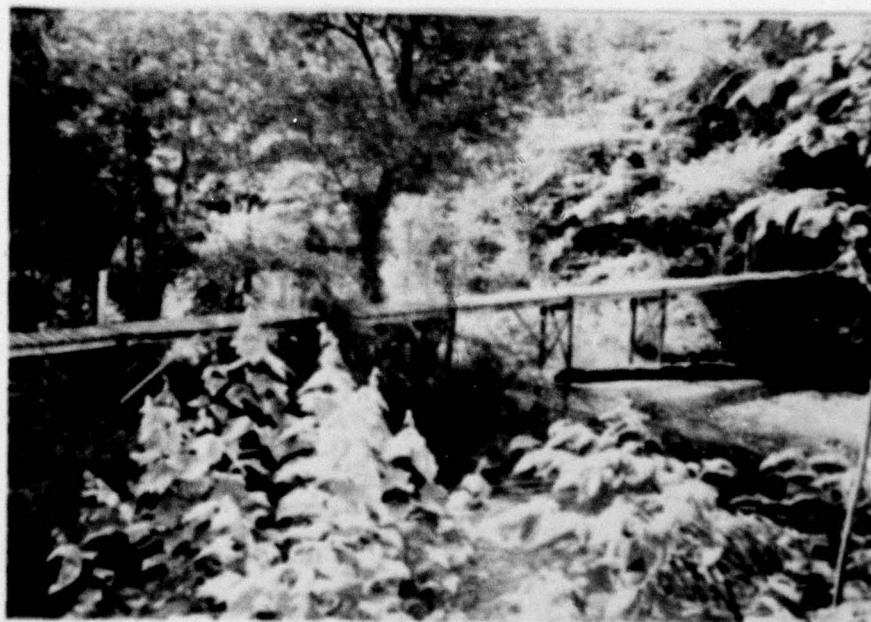


PHOTOGRAPH NO. 4
Old Mill House at Left Abutment

GREGORY'S DAM



PHOTOGRAPH NO. 5
2-foot x 2-foot Box Culvert



PHOTOGRAPH NO. 6
Downstream

APPENDIX III
FIELD OBSERVATIONS

Check List
Visual Inspection
Phase I

Name Gregory's Pond Dam County Chesterfield State Virginia Coordinates Lat. 3727.0
Long. 7734.2

Date(s) Inspection 6/26/79 Weather Clear Temperature 65 degrees F

Pool Elevation at Time of Inspection 167.0 M.S.L. Tailwater at Time of Inspection 155.8 M.S.L.

Inspection Personnel:

Bob Bates, Owners Representative Curt Linderman, S.W.C.B.

Billy Walton, Owners Representative John Kemper, Law Engineering

Tan Young, DDM&A

Paul Seiler, DDM&A Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE	Leaks at bottom in the mill house wall and in front of the dam where natural rock ends at tailwater.	See page iii, Downstream face picture for the natural rock and leakage.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	No obvious settlement, no erosion visible.	
DRAINS	No drains were observed during the inspection.	
WATER PASSAGES	None.	
FOUNDATION	Masonry gravity type foundation	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	Small displacements on both vertical and horizontal alignment.	See photographs, overview of dam on page 111 and No.'s 1 & 2.
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	None observed.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed.	
INTAKE STRUCTURE	None.	
OUTLET STRUCTURE	None.	
OUTLET CHANNEL	The outlet channel is the natural stream.	
EMERGENCY GATE	2-foot slide gate.	

SPILLWAY

VISUAL EXAMINATION OF		OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MASONRY WEIR		The masonry weir appeared to be in fair condition. There appears to be a slight bulge in the crest. Water was flowing over the spillway at the time of the inspection.	
APPROACH CHANNEL		Natural stream.	
DISCHARGE CHANNEL		Natural stream.	
BRIDGE AND PIERS		N/A	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The reservoir slopes are flat approximately 3%. The surrounding area is heavily wooded.	
SEDIMENTATION	Unknown.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The stream bed is approximately 100 feet wide with debris in it. There is no riprap protection on the downstream channel. Trees and heavy underbrush line the channel. No debris or obstructions were observed.	
SLOPES	Slopes are approximately 2 to 7%. Forested.	
APPROXIMATE NO. OF HOMES AND POPULATION	There are no structures immediately downstream. In about one mile downstream, there are two homes in Falling Creek Farms and five homes in Longwood acres near the stream.	

GRAVITY DAM DESIGN

STABILITY ANALYSIS

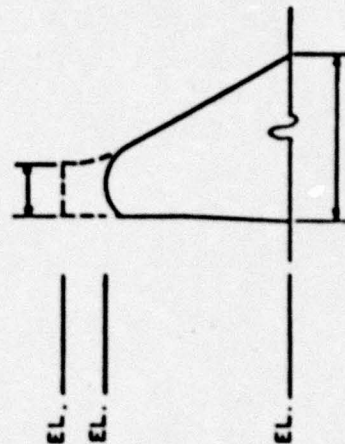
GREGORY'S DAM

ANALYSIS DONE ON X FULL SECTION — PARTIAL SECTION

LOCATION OF SECTION — CENTER OF SPILLWAY

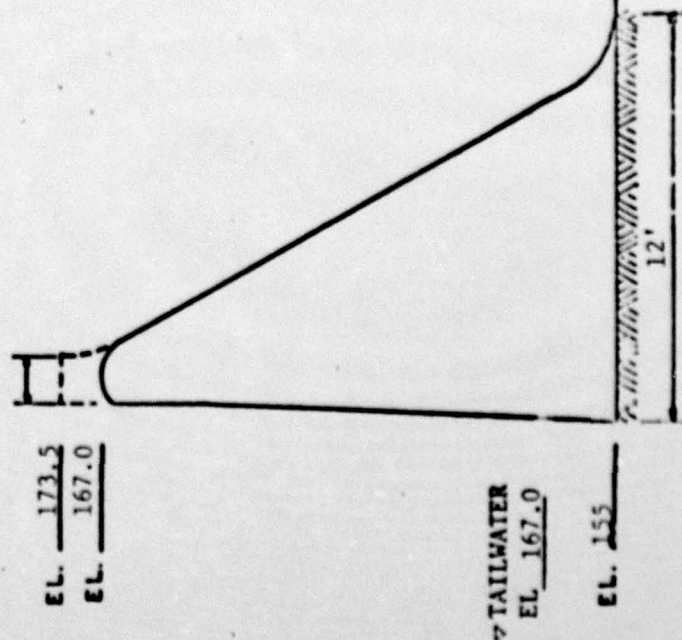
ANALYSIS PREPARED BY _____

LOADING CASE	ELEV. HEAD WATER	ELEV. TAIL WATER	ΣV	ΣH	$\frac{\Sigma H}{\Sigma V}$	LOCATION RESULTANT FROM TOE	% BASE COMPRESSION IN	FACTOR SAFETY SLIDING	FOUNDATION PRESSURE	
									TOE	HEEL
NORMAL POOL	167	155	10.08 ^k	4.5 ^k	0.45	4'			1.7	--
100-YEAR FLOOD	173.5	167	8.0 ^k	6.2 ^k	0.78	4'			1.3	--



PARTIAL SECTION

THIS ANALYSIS IS BASED ON THE ASSUMED GEOMETRIC CONFIGURATION SINCE NO DRAWINGS WERE AVAILABLE TO VERIFY THE DIMENSIONS OF THE DAM.



APPENDIX IV

REFERENCES

LIST OF REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Department of the Army, Office of the Chief of Engineers, Washington, D.C. 20314
2. HEC-1 Flood Hydrograph Package, Hydrologic Engineering Center, U S Army, Corps of Engineers Davis, California 95616, 1973.
3. U S Weather Bureau and U S Army Corps of Engineers, "Seasonal Variation of Probable Maximum Precipitation East of the 105th Median for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24 and 48 hours", Hydrometeorological Report No. 33, Washington, D.C., April 1956.
4. Hershfield, David M., "Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years", Cooperative Studies Section, U S Weather Bureau Technical Paper No. 40, Washington, D.C., 1961.